Teachers' Guide

EVALUATION CARDS FOR KEYS TO CHEMISTRY

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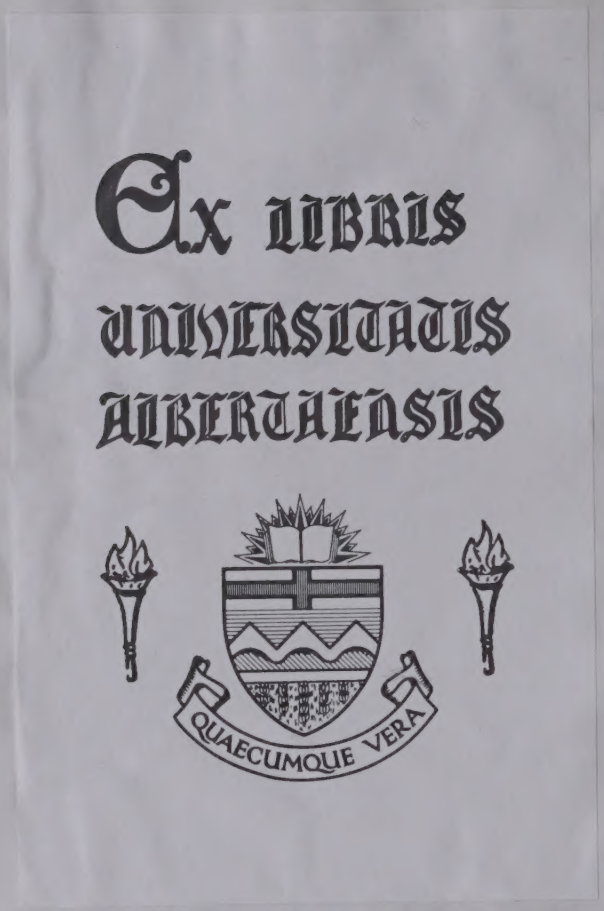

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THE TESTING PROGRAM

The testing program for KEYS TO CHEMISTRY consists of a deck of 330 Evaluation Cards, plus this teachers' guide, which contains answers and sample forms for the answer sheets and report sheets (on which the student receives from the teacher an analysis of his test results).

All test questions are tied closely to the performance objectives. The nonlaboratory questions are similar to the practice exercises and self-tests in the text. A student who has understood the laboratory work and done well on the self-test should have no trouble on the chapter test.

There are 30 cards for each of the 11 chapters. The cards are coded, both by color and by capital-letter code, to indicate the type of material being tested:

Color	Letter Code	Type of Material
White	L	Laboratory practical
Green	M	Mathematical problem and/or formulas or equations
Blue	I	Interpretation of data
Pink	F	Factual information
Orange	AU	Application and understanding of principles
Gold	H	Honor question

For each chapter there are five cards of each color, labelled a, b, c, d, and e. The questions on each of the five cards of one color are as parallel as possible.

To take a test, the student draws one card of each color (except gold). Thus, a maximum of five students can take a test on the same chapter on the same day from one deck of Evaluation Cards. When the course is self-paced, one deck of cards is sufficient for the entire class. The cards are re-usable and should last for the lifetime of the text. A protective coating makes it easy to remove stray marks.

The student taking the test is given an answer sheet, a kit for the laboratory question drawn, and a sheet of instructions for the assertion-reason or multiple-completion questions. Sample answer sheets and the sheet of instructions are printed in this booklet. These may be reproduced in quantity by any means you find convenient. On the answer sheet the student is asked to list the complete code number for each card drawn. To correct the test, you would look up the answer for that code number in this guide.

The lab kits can be made up in advance in tote boxes, as suggested for the regular laboratory program. These tote boxes should be labelled with the code number for the corresponding card and should contain the special materials and reagents required. In several chapters the questions on all five white cards are identical, but different materials should be put in each box to provide variety.

The use of Evaluation Cards in testing is recommended for several reasons. First, this is an attempt to make testing an individual matter and to remove the element of competition common in traditional testing. Second, in this method of testing it is easy to include a laboratory practical question, which is most important in evaluating achievement in science courses. A third advantage of this type of testing is that a real effort can be made to include questions to cover a wider range of skills. The deck of cards for each chapter tests five different skills.

Laboratory Skills (White cards): In the card deck for each chapter (where it is practical) the student is asked to perform some assignment in the laboratory, and to interpret his observations. These assignments are closely related to his work on the chapter just concluded. The tests for Chapters 9 and 10 include pencil and paper exercises designed to measure knowledge gained in the laboratory.

Mathematical and Equation-Writing Skills (Green cards): For the chapters where mathematical manipulations are an integral part of the material studied, problems are given on the test which involve these same concepts. In chapters where no problems are introduced, the green cards have questions which cover some other phase of the material.

For example, Chapter 10 (Ionic Equations) contains no type of problem-solving activity. Therefore, the green card questions are concerned with the structure of various types of unit cell. Such exceptions to the general testing pattern are encountered in a few cases.

Data Interpretation (Blue cards): In almost every case, questions on the cards are designed to measure the ability of the student to interpret data. This is accomplished by presenting graphs together with general questions pertaining to them. Or it may be done by presenting a problem or making a statement which involves an interpretation of concepts and principles studied.

Factual Material (Pink cards): For the most part, questions on the pink cards are multiple-choice and cover purely factual information. In other cases, the questions require a knowledge of facts for proper answers. It is worth noting that by using the Evaluation Cards, only one-fifth of the test deals with facts as such.

Application and Understanding of Principles (Orange Cards): In general, these questions are of the assertion-reason or the multiple-completion type. These are designed to test the ability of the student to apply the knowledge he has acquired and to probe into the thoroughness of his understanding of the major concepts and principles.

Honor Questions (Gold cards): These questions are more difficult, cover more advanced or theoretical material, and should be attempted only by students who have done well on the other questions in the chapter test.

When the individual progress plan is used, a student may take a test on any day that he wishes. It is suggested that all students wishing to take a test during a given period present themselves as soon as roll is checked. This allows them to use the entire period if necessary, and also frees the teacher to work with others in the laboratory or in discussion as needed.

After correcting the test, the teacher fills out a report sheet (which may be reproduced in quantity from this guide). It gives the student's score and advises the student whether to proceed to the next chapter or review the chapter and take another test on it. The report sheet for each chapter lists the topics covered in the chapter, so the teacher can check off what topics in particular the student should review.

When repeating a test, students draw from the same deck of cards. If they happen to draw one or more of the same cards, we do not consider this to be a disaster.

If the student makes a certain score on his first test attempt, he is eligible to draw an honor (gold) card. Honor questions are optional, and in no case are they to count against a student's grade.

ACKNOWLEDGMENT

The idea of creating a unique test for each student by putting questions on cards to be drawn by the student originated with Jane Garden of Thornlea School in Toronto, Canada. The author gratefully acknowledges her contribution and wishes to thank her for sharing her idea.

ANSWERS TO QUESTIONS ON EVALUATION CARDS

CHAPTER 1
THE A, B, C's OF CHEMISTRY

In addition to answering questions on the Evaluation Cards for this chapter, each student should identify common pieces of laboratory apparatus and equipment. An answer sheet for this identification is included in this guide. Each piece should be clearly labeled with a number. Students should be told in advance of this task, so they may study the pieces and learn their names.

White Cards

1-L (a...e) Objects of various materials and of both regular and irregular shapes should be assembled in small boxes or paper cups labeled 1-L (a), 1-L (b), etc., so that when a student draws a card it is a simple matter to hand him the proper container. The density of each object can be determined ahead of time and entered on the grading key. This facilitates scoring. Balances and graduated cylinders can be set up for reading as needed and changed for each student.

Green Cards

1-M (a) 1. mass = density × volume
= (2.70 g/cc) × (15.0 cc)
= 40.5 g

2. a. 3 b. 4

1-M (b) 1. volume = mass ÷ density
= (24.0 g) ÷ (10.5 g/cc)
= 2.28 cc

2. a. 5 b. 2

1-M (c) 1. percentage error = $\frac{\text{measured value - standard value}}{\text{standard value}} \times 100\% =$

$\frac{7.10 \text{ g/cc} - 7.30 \text{ g/cc}}{7.30 \text{ g/cc}} \times 100\% =$

2.7% (ignoring minus sign)

2. a. 4 b. 1

1-M (d) 1. density = mass ÷ volume
= (60.1 g) ÷ (6.75 cc)
= 8.90 g/cc

2. a. 6 b. 5

1-M (e) 1. mass = density × volume
= (19.3 g/cc) × (6.12 cc)
= 118 g

2. a. 3 b. 5

Blue Cards

1-I (a) 1. a. -0.077 ft/gallon

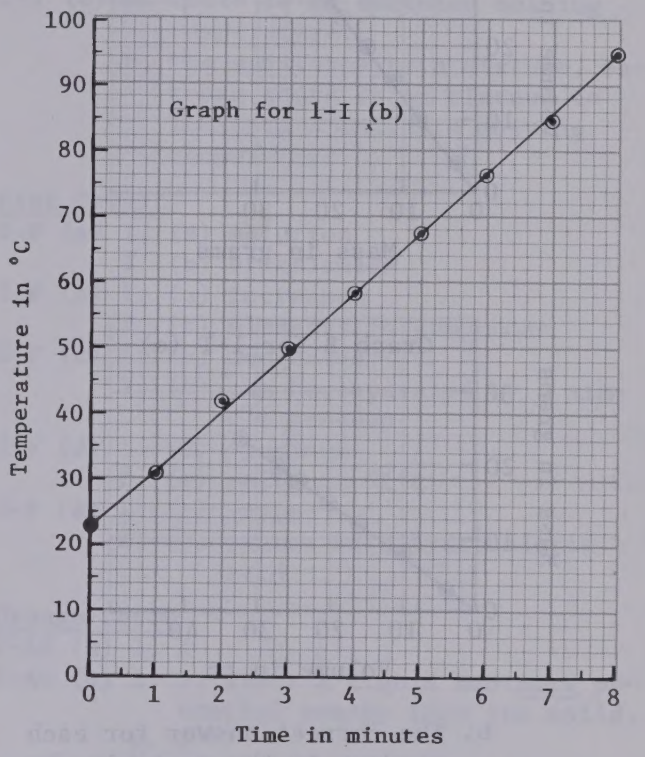
Blue Cards (con't.)

1-I (a) b. It is the amount the depth decreases per gallon of water withdrawn.

c. At this point the depth is zero, and all the water has been withdrawn.

d. The maximum depth is the depth when zero gallons have been withdrawn. Extrapolation to the y-axis gives 8.0 ft.

1-I (b) 1. a. See graph below.



b. The slope is 9.0°C/min.

c. It is the temperature of the water at the beginning of the measurements, i.e., room temperature.

d. Time is the independent variable.

1-I (c) 1. a. 0.020 ft/gallon.

b. It is the amount the depth increases per gallon of liquid added.

c. At the origin the depth is zero, and the tank is completely empty.

d. Multiplying the slope by 1500 gallons gives a depth of 30 ft.

1-I (d) 1. a. 1.6°C/min.

b. It is the amount the temperature increases per minute of

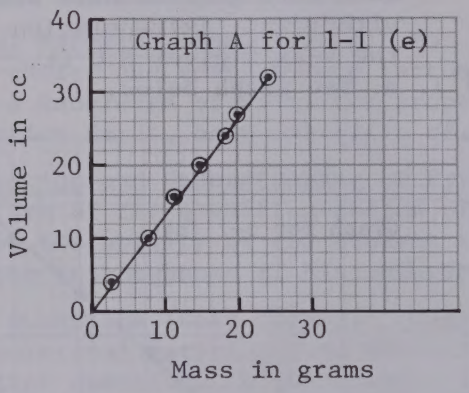
Blue Cards (con't.)

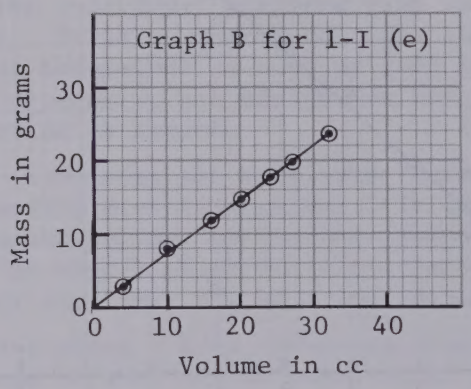
heating.

c. It is the temperature of the water at the beginning of the measurements.

d. 57°C

1-I (e) 1. a. See graphs below. (Student's graph may resemble either Graph A or Graph B.)





b. The correct answer for each student is the variable she or he chose for the vertical axis.

c. Graph A (volume vs. mass): 1.3 cc/g. Graph B (mass vs. volume): 0.75 g/cc.

d. 38 g (no matter which graph is used).

Pink Cards

1-F (a) 1. (a) meter
2. (b) takes up space

1-F (b) 1. (a) 1
2. (a) two opposing processes are going on at an equal rate.

1-F (c) 1. (c) gaseous 2. (a) 1

1-F (d) 1. (c) increase
2. (c) an interpretation of an observation.

1-F (e) 1. (d) beaker, 50 ml
2. (d) 10 g sugar when dissolved in 500 cc water.

Orange Cards

1-AU(a) 1. A, since only 1, 2, and 3 are correct.
2. D, since only 4 is correct.

1-AU(b) 1. D, since only 4 is correct.
2. B, since only 1 and 3 are correct.

1-AU(c) 1. D, since only 4 is correct.
2. C, since only 2 and 4 are correct.

1-AU(d) 1. B, since only 1 and 3 are correct.
2. B, since only 1 and 3 are correct.

1-AU(e) 1. C, since only 2 and 4 are correct.
2. A, since only 1, 2, and 3 are correct.

Gold Cards

1-H (a) 1. a. maximum randomness
b. maximum randomness
c. maximum randomness

1-H (b) 1. a, b, c, and f

1-H (c) 1. mass = volume × density
= (15 cc) × [(500 g) ÷ (30 cc)]
= 375 g

1-H (d) 1. (b) 0.0369 kilogram

1-H (e) 1. volume = (2.0 cc/°C) × (20°C) + 546 cc
= 586 cc

CHAPTER 2
CLASSIFICATION OF MATTER

White Cards

2-L (a...e) For Question 1 on each card it is recommended that small vials be prepared with the labels A, B, C, etc. Each student should be given a minimum of 5 vials containing samples of metals and nonmetals; samples of homogeneous and heterogeneous matter; samples of elements, mixtures, and compounds; or a variety of these substances. He will then classify the matter as directed on the test card by listing the proper identification letters in the proper place on the test sheet. (On card 2-L (c), any logical classification scheme should receive credit.)

Suggestions for Question 2 on each card:

2-L (a)(b) The test tubes could contain one of the following. Physical change when heated: a tiny bit of roll sulfur (will melt), a tiny bit of iodine crystal (will sub-

White Cards (con't.)

lime into a purple vapor), a few drops of water (will boil); chemical change when heated: small amount of sugar (will blacken), small amount of soluble starch (will blacken). The test tubes should be tightly stoppered. The physical changes may reverse themselves at the top of the tubes, which will be cooler than the bottoms. The test tubes should be prepared in quantity, as each can be used by only one student.

2-L (c) Credit for the proposed plan for separating the mixture should be given if the proposal is reasonable on the basis of what the student can observe without opening the container.

2-L (d) Any proposal about how to break up the compound is a guess. Evaluation should involve credit for creative and original answers and not be dependent upon any specific answer.

2-L (e) See comment for 2-L (c).

Green Cards

2-M (a) 1a. Pb 2a. chlorine
b. Hg b. potassium
c. Na

2-M (b) 1a. O 2a. calcium
b. Fe b. magnesium
c. K

2-M (c) 1a. Al 2a. nickel
b. Ba b. copper
c. Zn

2-M (d) 1a. C 2a. fluorine
b. Sn b. bromine
c. Fe

2-M (e) 1a. Co 2a. iodine
b. Cr b. lithium
c. He

Blue Cards

2-I (a) 1a. No, it is just the opposite. Reason: As the distance between unlike poles decreases, the attraction becomes greater and the apparent weight decreases.

b. The student should check the poles on the magnets. She or he evidently placed like poles facing and thought they were unlike.

2-I (b) 1a. 44°C b. 44°C

c. The substance is pure, because it has a definite melting-

Blue Cards (con't.)

freezing temperature, as indicated by the plateau.

2-I (c) 1a. Curve A, since the apparent weight is greater than the actual weight for like poles.

b. Point 1, since work is required to bring like poles closer together.

2-I (d) 1a. 51°C b. 51°C

c. The substance is pure, because it has a definite freezing-melting temperature, as indicated by the plateau.

2-I (e) 1a. There is no definite melting temperature.

b. The substance is a mixture, because there is no plateau to indicate a definite melting temperature.

Pink Cards

2-F (a) 1. (d) solution
2. (b) brittleness

2-F (b) 1. (a) increases
2. (b) elements in compounds

2-F (c) 1. (b) decreases
2. (b) can be separated by a simple process

2-F (d) 1. (d) aluminum
2. (c) melts at 51°C

2-F (e) 1. (c) oxygen
2. (b) reacts with hydrochloric acid

Orange Cards

2-AU (a) 1. A 2. A

2-AU (b) 1. D, since a liquid has more potential energy than its solid.
2. A

2-AU (c) 1. E, since the potential energy decreases, and potential energy is changed to kinetic.
2. B, since the reason doesn't explain the assertion.

2-AU (d) 1. C, since potential energy would be changed to kinetic.
2. A

2-AU (e) 1. A 2. A

Gold Cards

2-H (a) 1. In a homogeneous mixture (example: salt dissolved in water) the substances are mixed together so evenly that they cannot be distinguished even with microscopes. In a heterogeneous mixture (example: cinnamon mixed with sugar) the substances can be distinguished by inspection.

Gold Cards (con't.)

2-H (b) 1. A compound (example: salt) is a chemical combination of two or more substances. The proportions of the substances are always the same for that compound. A homogeneous mixture (example: salt dissolved in water) is a physical combination of two substances which may be present in any proportion.

2-H (c) 1. A metal (example: aluminum) is generally shiny, can be hammered or pressed into thin sheets or drawn into a wire, and is a good conductor of heat and electricity. A metalloid (example: silicon) shares some properties with metals and some with nonmetals.

2-H (d) 1. % by weight of sodium = (23.0 g) ÷ (23.0 g + 35.5 g) = 39.3%

2-H (e) 1. % by weight of copper = (63.5 g) ÷ (63.5 g + 32.1 g) = 66.4%

CHAPTER 3
PROPERTIES OF LIQUIDS AND THE SOLUTION PROCESS

White Cards

3-L (a)(e) Some students should be given liquids with a dissolved solid, others liquids with no dissolved solid. Students should dry a few drops on a slide held over a burner flame to see whether a residue appears.

3-L (b)(c) Examples of systems that may be given to student are as follows. Steady-state: a gas burner flame; equilibrium: a saturated solution containing excess solid; a liquid that partially fills a capped vial; (for good students only) a vial containing both water and carbon tetrachloride that has been colored by adding iodine to it.

3-L (d) Most common solids dissolve with so little increase or decrease in energy that the solution does not show an appreciable change in temperature. The following solids are recommended. Endothermic: NH_4Cl, KNO_3, KCl; exothermic: NaOH, KOH, anhydrous $CuSO_4$.

Green Cards

3-M (a) 1. One liter of 1M sodium hydroxide contains (23.0 + 16.0 + 1.0), or 40.0 grams of solute. Therefore, 500 cc of 1M solution contains (40.0 grams) ÷ 2 = 20.0 grams of solute.

3-M (b) 1. One liter of 1M potassium chloride contains (39.1 + 35.5), or 74.6, grams of solute. Therefore, 100 cc of 0.5M solution contains 0.5 × (74.6 grams) ÷ 10 = 3.73 grams of solute.

3-M (c) 1. One liter of 1M sodium bromide contains (39.1 + 79.9), or 119.0, grams of solute. Therefore, 250 cc of 0.1M solution contains 0.1 × (119.0 grams) ÷ 4 = 2.98 grams of solute.

3-M (d) 1. One liter of 1M potassium nitrate contains [39.1 + 14.0 + (3 × 16.0)], or 101.1, grams of solute. Therefore, 1 liter of 0.5M solution contains 0.5 × (101.1 grams) = 50.6 grams of solute.

3-M (e) 1. One liter of 1M calcium chloride contains [40.1 + (2 × 35.5)], or 111.1, grams of solute. Therefore, 250 cc of 1.0M solution contains (111.1 grams) ÷ 4 = 27.8 grams of solute.

Blue Cards

3-I (a) 1. NaCl 2. 22°C

3-I (b) 1. KNO_3 2. $Ce_2(SO_4)_3$

3-I (c) 1. 10 grams 2. 21°C (KNO_3 and KCl)

3-I (d) 1. 74°C 2. NaCl

3-I (e) 1. 110 grams
2. 7°C

Pink Cards

3-F (a) 1. (d) evaporation
2. (a) methanol

3-F (b) 1. (b) saturated 2. (d) pressure

3-F (c) 1. (b) decrease 2. (b) increases

3-F (d) 1. (a) increase
2. (d) acetic acid

3-F (e) 1. (a) 1M
2. (c) supersaturated

Orange Cards

3-AU(a) 1. A
2. E, since the system will form more gas, and the pressure on the liquid would have been decreased.

3-AU(b) 1. B
2. E, since only 1 and 4 are correct.

Orange Cards (con't.)

3-AU(c) 1. D, since gases are less soluble as temperature increases.
2. A

3-AU(d) 1. D 2. A

3-AU(e) 1. C 2. A

Gold Cards

3-H (a) The reverse reaction will be favored. According to LeChatelier's Principle, the system will react in such a way as to "use up" the added heat.

3-H (b) See student text, p. 81.

3-H (c) See student text, p. 70.

3-H (d) Measure maximum amount of compound that will dissolve in 100 grams of water at various temperatures. Report should include graph of solubility in grams per 100 grams of water vs. temperature in °C.

3-H (e) See student text, pp. 83 and 86. Examples may include solids dissolved in Exp. 3-4.

CHAPTER 4
ACIDS, BASES, AND SALTS

White Cards

4-L (a...e) Dilute solutions of acids and bases should be placed in capped vials or stoppered test tubes.

Green Cards

4-M (a) 1. pH = 3 2. sulfuric acid

4-M (b) 1. pH = 2 2. magnesium hydroxide

4-M (c) 1. pH = 6 2. calcium hydroxide

4-M (d) 1. pH = 4 2. nitric acid

4-M (e) 1. pH = 0 2. acetic acid

Blue Cards

4-I (a) 1. The equilibrium would shift to the left and reduce the concentration of the H_3O^+ ion.

4-I (b) 1. The equilibrium would shift to the right and increase the concentration of H_3O^+ and $C_2H_3O_2^-$ ions.

4-I (c) 1. a. neutral b. basic

4-I (d) 1. a. basic b. neutral

4-I (e) 1. a. acidic b. neutral

Pink Cards

4-F (a) 1. (c) strong base 2. (b) sugar

4-F (b) 1. (c) $HC_2H_3O_2$
2. (d) colorless

4-F (c) 1. (b) H_3O^+ 2. (b) NH_3

4-F (d) 1. (d) 10
2. (b) weak acid

4-F (e) 1. (d) red
2. (b) a proton acceptor

Orange Cards

4-AU(a) 1. B 2. E

4-AU(b) 1. D, since buffer solutions resist changes in pH for the reason stated.
2. A

4-AU(c) 1. A 2. A

4-AU(d) 1. B
2. E, since 1 and 2 are correct.

4-AU(e) 1. E, since Na_2SO_4 forms a neutral solution, and Na^+ ions do not react with OH^- ions.
2. D, since water is a weaker base than NH_3.

Gold Cards

4-H (a) 1. Answers vary. Example:
$HCl + NaOH \rightarrow NaCl + H_2O$

4-H (b) 1. $NH_4Cl \rightarrow NH_4^+ + Cl^-$
$NH_4^+ + H_2O \rightleftarrows H_3O^+ + NH_3$

4-H (c) 1. NH_3 is considered to be a better base than H_2O, because when the two are mixed in solution, NH_3 takes protons from H_2O in the reaction
$NH_3 + H_2O \rightleftarrows NH_4^+ + OH^-$

4-H (d) 1. $NaC_2H_3O_2 \rightarrow Na^+ + C_2H_3O_2^-$
$C_2H_3O_2^- + H_2O \rightleftarrows HC_2H_3O_2 + OH^-$

4-H (e) 1. Sulfuric acid is a strong electrolyte because it ionizes completely in water solution. Acetic acid is a weak electrolyte because in water solution the number of ions formed is considerably less than the number of acetic acid molecules.

CHAPTER 5
THE DEVELOPMENT OF ATOMIC THEORY

White Cards

5-L (a...e) Students should be given a sample of a solution containing one of the metallic ions that can be identified by a flame test, borax bead test, or cobalt nitrate test.

Green Cards

5-M (a) 1. x-rays 2. CO

5-M (b) 1. gamma rays 2. NO

5-M (c) 1. x-rays 2. NO_2

5-M (d) 1. ultraviolet rays 2. CO_2

5-M (e) 1. x-rays 2. CO

Blue Cards

5-I (a) 1. (d)

5-I (b) 1. (b)

5-I (c) 1. (c)

5-I (d) 1. (b)

5-I (e) 1. (c)

Pink Cards

5-F (a) 1. a. Rutherford b. Thomson
c. Becquerel d. Bohr

5-F (b) 1. a. Democritus b. Dalton
c. Avogadro d. Planck

5-F (c) 1. a. Planck b. Dalton
c. Millikan
d. Soddy and Richards

5-F (d) 1. a. Thomson b. Democritus
c. Einstein d. Bohr

5-F (e) 1. a. Newton b. Becquerel
c. Millikan d. Rutherford

Orange Cards

5-AU(a) 1. D, since Thomson believed cathode rays were particles (electrons).
2. C, since uranium does give off rays in the dark.

5-AU(b) 1. C, since the wave theory cannot explain the hydrogen spectrum.
2. A

5-AU(c) 1. A
2. C, since the copper ions are responsible for the green color.

5-AU(d) 1. A 2. B

5-AU(e) 1. E, since useful theories must be able to be tested objectively and must explain facts.
2. D, since Rutherford thought the centers were positively charged.

Gold Cards

5-H (a) 1. Answers vary—see Sec. 5-12.

5-H (b) 1. Answers vary—see Sec. 5-4.

5-H (c) 1. Answers vary—see Sec. 5-7.

5-H (d) 1. Answers vary—see Sec. 5-3.

5-H (e) 1. Answers vary—see Sec. 5-7.

CHAPTER 6
THE ELECTRONIC STRUCTURE OF ATOMS AND THE PERIODIC LAW

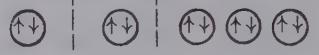
White Cards

6-L (a)(b) Students should be given 2 cc of one of the following solutions:
0.2M $AgNO_3$
0.2M $Pb(NO_3)_2$
0.05M $Hg_2(NO_3)_2$

(c)(d)(e) Students should be given 2 cc of one of the following solutions:
0.2M $SbCl_3$
0.2M $Bi(NO_3)_3$
0.2M $HgCl_2$
0.2M $Cu(NO_3)_2$

Green Cards

6-M (a) 1. a. $1s^2\ 2s^2\ 2p^6$
b. 1s | 2s | 2p

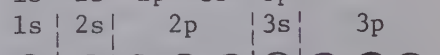


c. $:\ddot{N}e:$

6-M (b) 1. a. $1s^2\ 2s^2\ 2p^6\ 3s^1$
b. 1s | 2s | 2p | 3s

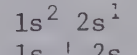
c. $Na\cdot$

6-M (c) 1. a. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$
b. 1s | 2s | 2p | 3s | 3p



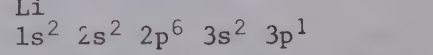
c. $:\ddot{Cl}\cdot$

6-M (d) 1. a. $1s^2\ 2s^1$
b. 1s | 2s



c. $Li\cdot$

6-M (e) 1. a. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$
b. 1s | 2s | 2p | 3s | 3p



c. $Al\cdot$

Blue Cards

6-I (a) 1. A 2. A 3. E 4. D 5. E

6-I (b) 1. F 2. A 3. C, D
4. F 5. A

6-I (c) 1. E, D, C, B, A
2. A, B, C, D, E
3. A 4. D 5. E

6-I (d) 1. F 2. A 3. D 4. A 5. F

6-I (e) 1. B, C, D, E, F
2. G 3. F 4. A 5. C

Pink Cards

6-F (a) 1. (a) the number of protons in the nucleus determines the properties of an element.
2. Any two of the following: ionization energy, atomic radius, number of electrons in the outer energy level.

6-F (b) 1. The number of electrons in the outer energy level. Examples vary: alkali metals have only one outer electron; noble gases have 8 outer electrons (except for helium); etc.
2. See Sec. 6-2.

6-F (c) 1. The atomic number of an atom is the number of protons in its nucleus.

Pink Cards (con't.)

6-F (c) 2. a. Within the same family, ionization energy decreases as atomic number increases.

b. Within the same period, ionization energy tends to increase as atomic number increases.

6-F (d) 1.

Particle	Charge	Relative Mass
proton	+	1
neutron	0	1
electron	-	0

2.

Possible orbital	Maximum number of electrons
4s	2
4p	6
4d	10
4f	14
Total maximum:	32

6-F (e) 1. (c) 100,000 times that of the nucleus

2. (c) whose 4f orbitals are filling

Orange Cards

6-AU(a) 1. D, since the atomic radius tends to decrease.

2. A

6-AU(b) 1. A 2. B

6-AU(c) 1. A

2. E, since the modern periodic table is based upon atomic number, which is more reliable than atomic weight.

6-AU(d) 1. A

2. E, since 2, 3, and 4 are correct.

6-AU(e) 1. D 2. B

Gold Cards

6-H (a) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6\ 4d^{10}\ 4f^{14}\ 5s^2\ 5p^6\ 5d^{10}\ 5f^{14}\ 6s^2\ 6p^6\ 6d^3\ 7s^2$

Its position should be in the seventh row, since the 7th energy level is outermost, and under the other transition elements with three d electrons in the next-to-outermost level (i.e., under vanadium).

6-H (b) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6\ 4d^{10}\ 4f^{14}\ 5s^2\ 5p^6\ 5d^{10}\ 5f^{14}\ 6s^2\ 6p^6\ 6d^{10}\ 7s^2\ 7p^6$

Its position should be in the seventh row, since the 7th energy level is outermost, and under the noble gases, since it has completely filled p orbitals in the outer energy level.

Gold Cards (con't.)

6-H (c) See Sec. 6-7. The improvement is the arrangement of elements according to increasing atomic number rather than atomic weight.

6-H (d) The transition elements have similar electron configurations in their outermost energy levels, and it is the outermost levels that determine the chemical properties.

6-H (e) Helium's chemical and physical properties resemble those of the noble gases (nonreactive, very high ionization energy, low melting point) rather than the family headed by beryllium. Apparently, the fact that the first energy level is completely filled is more important than the fact that it contains only two electrons.

CHAPTER 7
CHEMICAL BONDING

Note: Students taking a test on this chapter should have access to a copy of the periodic table of electronegativities (p. 184 of text or p. 136 of lab manual).

White Cards

7-L (a...e) Preparation of laboratory kits for the test questions 7-L (a...e):

The following substances are suggested for student testing with water, carbon tetrachloride, and alcohol:

potassium chloride, KCl. . . . . ionic
sodium nitrate, $NaNO_3$. . . . . ionic
paraffin, $C_{25}H_{52}$ . . . . nonpolar covalent
silicon dioxide, SiO_2. . . . . .individual Si-O bonds are strongly polar, but the compound is made up of tetrahedral molecules that are nonpolar covalent. SiO_2 does not dissolve in any of the solvents provided in Experiment 7-1. Use this only with excellent students.
diphenyl, $C_{12}H_{10}$. .slightly polar covalent
potassium iodide, KI . . . . . ionic
naphthol, $C_{10}H_8O$. . . . nonpolar covalent

You are free to add others as you desire. Enough samples should be prepared so that the same substance is not used too frequently. Code the vials in some convenient manner and instruct students to write the code number of the vial which they receive on the answer sheet.

White Cards (con't.)

7-L Students should base answer on (a...e) solubility in each solvent:

Solute	Soluble in		
	H_2O	CCl_4	C_2H_5OH
Ionic	yes	no	no
Polar covalent	yes	no	somewhat
Nonpolar covalent	no	yes	yes

Green Cards

7-M (a) 1. a. ionic b. ionic
c. polar covalent
d. ionic e. ionic

7-M (b) 1. a. ionic b. ionic
c. ionic d. ionic
e. polar covalent

7-M (c) 1. a. polar covalent
b. polar covalent
c. ionic
d. polar covalent
e. polar covalent

7-M (d) 1. a. polar covalent
b. nonpolar covalent
c. polar covalent
d. ionic e. ionic

7-M (e) 1. a. polar covalent
b. nonpolar covalent
c. polar covalent
d. ionic
e. polar covalent

Blue Cards

7-I (a) 1. (d) LiBr 2. (c) O_2

7-I (b) 1. (d) H_2O 2. (e) LiCl

7-I (c) 1. (b) NaF 2. (e) NaCl

7-I (d) 1. (d) H_2O 2. (c) CsCl

7-I (e) 1. (a) CsCl 2. (e) NaAt

Pink Cards

7-F (a) 1.  2. (d)

7-F (b) 1.  2. (a)

7-F (c) 1.  2. (c)

7-F (d) 1.  2. (b)

7-F (e) 1.  2. (a)

Orange Cards

7-AU(a) 1. A
2. C, since the atomic radius is decreasing.

7-AU(b) 1. A
2. E, since NaCl is an empirical formula and sodium chloride is an ionic compound with no molecules.

7-AU(c) 1. B, since the reason and assertion are reversed.
2. A

7-AU(d) 1. C, since the force of attraction decreases.
2. E, since CCl_4 is insoluble in water, and hydrogen bonds cannot form between water and a nonpolar molecule like CCl_4.

7-AU(e) 1. A 2. A

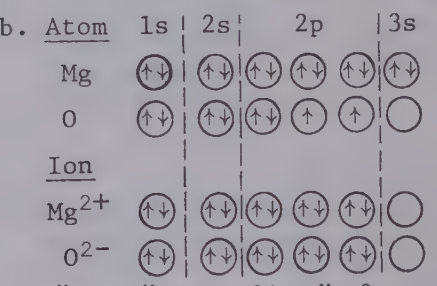
Gold Cards

7-H (a) 1. a. Energy + Mg → Mg^{2+} + $2e^-$

$4e^-$ + O_2 → $2O^{2-}$ + energy

O^{2-} + Mg^{2+} → $Mg^{2+}O^{2-}$ + energy

b.



c. $\ddot{M}g + :\dot{\ddot{O}}\cdot \rightarrow Mg^{2+} \; :\ddot{O}: ^{2-}$

d. The melting point of MgO should be high, since it is an ionic compound.

7-H (b) 1. In general, if the electronegativity difference between the two elements is 1.8 or greater, the bond will be ionic; if it is zero, the bond will be nonpolar covalent; if it is greater than zero but less than 1.8, the bond will be polar covalent.
2. ionic: sodium chloride, NaCl
nonpolar covalent: oxygen, O_2
polar covalent: water, H_2O

7-H (c) 1. A stable chemical bond will form between two atoms only if the resulting combination has less energy than the separate atoms.
2. Between atoms: Ionic, covalent (polar and nonpolar), metallic. Between molecules: Van der Waals, hydrogen bonds.

7-H (d) 1. a. Internally, the molecules are held together by polar covalent bonds. Externally, the molecules are held to each other by van der Waals forces. (These forces are

Gold Cards (con't.)

extremely weak for methane, so it is a gas at room temperature.)

b. Neither compound would be expected to be soluble in water, since the molecules are symmetrical and do not form bonds with polar water molecules.

7-H (e) 1. As two hydrogen atoms approach each other, the forces of attraction (between each nucleus and the electron on the other atom) are predominant and the potential energy decreases. At very short distances the forces of repulsion (between the pair of nuclei and between the two electrons) predominate. There is an optimum distance at which the attractive and repulsive forces balance and the potential energy is a minimum. The atoms can give up energy and form a covalent bond. This creates a hydrogen molecule, in which the two atoms are the optimum distance apart.

CHAPTER 8
QUANTITATIVE RELATIONSHIPS IN CHEMISTRY

White Cards

8-L (a...e) For each card a vial should be prepared ahead of time which contains known quantities of elements and/or compounds. Examples might be: 15g Cu shot; 25g sulfur; 100g Pb shot; 50g sugar; 10g sodium chloride, etc. The vial should carry a label telling what the substance is and its formula. Liquids may also be used: water, ethyl alcohol, glycerine, etc. Students will then determine the number of moles of the substance in the vial. It will be their responsibility to decide how this should be done.

Green Cards

8-M (a) 1. a. aluminum, sulfur, oxygen
b. 3
c. Al: 27 × 2 = 54
S: 32 × 3 = 96
O: 16 × 12 = 192
342
d. 342 grams

Green Cards (con't.)

8-M (b) 1. a. calcium, oxygen, hydrogen
b. 2
c. Ca: 40 × 1 = 40
O: 16 × 2 = 32
H: 1 × 2 = 2
74
d. 74 grams

8-M (c) 1. a. cobalt, nitrogen, oxygen
b. 6
c. Co: 59 × 1 = 59
N: 14 × 2 = 28
O: 16 × 6 = 96
183
d. 183 grams

8-M (d) 1. a. sodium, sulfur, oxygen
b. 1
c. Na: 23 × 2 = 46
S: 32 × 1 = 32
O: 16 × 4 = 64
142
d. 142 grams

8-M (e) 1. a. calcium, chlorine, oxygen
b. 2
c. Ca: 40.1 × 1 = 40.1
Cl: 35.5 × 2 = 71.0
O: 16.0 × 2 = 32.0
143.1
d. 143.1 grams

Blue Cards

8-I (a) 1. a. Hydrogen chloride (or hydrochloric acid) reacts with aluminum to form hydrogen (gas) and aluminum chloride.
b. $6HCl + 2Al \rightarrow 3H_2 + 2AlCl_3$

8-I (b) 1. a. Potassium reacts with water to form potassium hydroxide and hydrogen (gas).
b. $2K + 2H_2O \rightarrow 2KOH + H_2$

8-I (c) 1. a. Copper reacts with silver nitrate to form copper (II) nitrate and silver.
b. $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$

8-I (d) 1. a. Magnesium carbonate decomposes into magnesium oxide and carbon dioxide.
b. Sentence is balanced as is.

8-I (e) 1. a. Chlorine (gas) reacts with sodium iodide to form sodium chloride and iodine (gas).
b. $Cl_2 + 2NaI \rightarrow 2NaCl + I_2$

Pink Cards

8-F (a) 1. (b) decomposition
2. (b) NaCl

8-F (b) 1. (a) synthesis 2. (c) N_2O

8-F (c) 1. (d) ion-ion 2. (a) 1

8-F (d) 1. (c) metal-ion 2. (d) Fe_2O_3

8-F (e) 1. (c) ion-ion 2. (c) carbon-12

Orange Cards

8-AU(a) 1. A 2. B

8-AU(b) 1. C, since correct formulas should never be changed to balance an equation.

2. D, since carbon-12 is the present standard.

8-AU(c) 1. A 2. A

8-AU(d) 1. A 2. C

8-AU(e) 1. A 2. A

Gold Cards

8-H (a) 1. a. formula weight of HgO

Hg: $200 \times 1 = 200$

O: $16 \times 1 = \underline{16}$

216

Therefore, 1 mole of HgO weighs 216 grams. Number of moles of O_2 molecules = $\frac{1}{2} \times \frac{72 \text{ grams}}{216 \text{ grams}} = 0.17$ mole

b. Number of grams of O_2 = 0.17×32 grams = 5.4 grams

8-H (b) 1. a. Since 36g of C is 3 moles, then 2×3 moles, or 6 moles, of CO would be produced.

b. molecular weight of CO

C: $12 \times 1 = 12$

O: $16 \times 1 = \underline{16}$

28

weight of CO = 6×28 grams = 168 grams

8-H (c) 1. a. molecular weight of NH_3

N: $14 \times 1 = 14$

H: $1 \times 3 = \underline{3}$

17

Number of moles of N_2 = $\frac{1}{2} \times \frac{102 \text{ grams}}{17 \text{ grams}} = 3$ moles

b. Weight of $N_2 = 3 \times 28$ grams = 84 grams

8-H (d) 1. a. molecular weight of H_2O

H: $1 \times 2 = 2$

O: $16 \times 1 = \underline{16}$

18

Number of moles of O_2 = $\frac{1}{2} \times \frac{180 \text{ grams}}{18 \text{ grams}} = 5$ moles

b. Weight of $O_2 = 5 \times 32$ grams = 160 grams

8-H (e) 1. a. Number of moles of HF = $2 \times \frac{95 \text{ grams}}{38 \text{ grams}} = 5$ moles

b. Formula weight of HF

H: $1 \times 1 = 1$

F: $19 \times 1 = \underline{19}$

20

Weight of HF = 5×20 grams = 100 grams

CHAPTER 9

PROPERTIES OF THE GASEOUS STATE

White Cards

9-L (a)(b)(c) Students will need the apparatus for Exp. 9-2. You may request that different students use different sets of books, so the data will be different.

9-L (d)(e)

1. a. Place tube of trapped gas in water bath. Wait several minutes and measure temperature of water bath. Also measure length of trapped volume of gas. Repeat for water baths of different temperatures.

b. It would be a straight line, going upwards and to the right. It would not pass through the origin.

Green Cards

9-M (a) 1. Molecular weight = 36.5; density = 36.5 grams/22.4 liters = 1.63 grams/liter.

9-M (b) 1. Weight of one mole = 22.4 liters × (0.714 gram/liter) = 16.0 grams, so molecular weight = 16.0.

9-M (c) 1. Density = 32.0 grams/22.4 liters = 1.43 grams/liter.

9-M (d) 1. Weight of one mole = 22.4 liters × (1.53 grams/liter) = 34.3 grams, so molecular weight = 34.3.

9-M (e) 1. Molecular weight = 17.0; density = 17.0 grams/22.4 liters = 0.760.

Blue Cards

9-I (a) 1. Partial pressure = 740 torr - 18 torr = 722 torr

9-I (b) 1. Partial pressure = 735 torr - 18 torr = 717 torr.

$V_2 = P_1V_1/P_2$ = (717 torr) × (200 cc)/(760 torr) = 188 cc

9-I (c) 1. Partial pressure = 714 torr - 24 torr = 690 torr.

$P_2 = T_2P_1/T_1$ = (273°K) × (690 torr)/(298°K) = 632 torr.

9-I (d) 1. According to Charles' Law, the volume of a gas is proportional to the absolute temperature at constant pressure. Therefore, if the temperature increased, the volume must have also increased.

9-I (e) 1. According to Charles' Law, the volume of a gas is proportional

Blue Cards (con't.)

to the absolute temperature. According to Boyle's Law, the volume is inversely proportional to pressure. Since at S.T.P. the temperature would be lower and the pressure would be greater, both these changes tend to reduce the volume, so the volume would be less than 500 cc.

Pink Cards

9-F (a) 1. (c) diffusing at the same rate
2. (c) steadily increases

9-F (b) 1. (b) steadily decreases
2. (d) 760 torr

9-F (c) 1. (b) do not obey Charles' Law at very low temperatures
2. (b) subtract the vapor pressure of water from the barometer reading

9-F (d) 1. (c) compounds with hydrogen bonds have weaker attractions than ionic compounds
2. (c) low temperatures

9-F (e) 1. (b) doubling the temperature in °K
2. (b) high pressures

Orange Cards

9-AU(a) 1. E, since the vapor pressure of water should be subtracted, and volume is inversely proportional to pressure.
2. B

9-AU(b) 1. C, since carbon dioxide molecules come out of solution and increase the gas pressure under the cap.
2. E, since both statements are true only for high pressure.

9-AU(c) 1. A
2. D, since volumes are inversely proportional to pressure.

9-AU(d) 1. A 2. A

9-AU(e) 1. A
2. E, since equal volumes of gas contain the same number of molecules.

Gold Cards

9-H (a) 1. a. Weight of magnesium = (0.825 g/meter) × (0.0550 meter) = 0.0454 g

b. Number of moles of Mg = (0.0454 g)/(24.3 g/mole) = 0.00187 mole

c. Partial pressure of hydrogen = 758 torr - 24 torr = 734 torr

Gold Cards (con't.)

9-H (a) 1. d. Volume of hydrogen at S.T.P.

$$= 47.5 \text{ cc} \times \frac{734 \text{ torr}}{760 \text{ torr}} \times \frac{273°K}{298°K}$$

$$= 42.0 \text{ cc}$$

e. One mole of magnesium would have produced

$$42.0 \text{ cc} \times \frac{1 \text{ mole}}{0.00187 \text{ mole}} =$$

22,400 cc = 22.4 liters

9-H (b) 1. a. N: 30.51 ÷ 14.0 = 2.18
O: 69.49 ÷ 16.0 = 4.34
There is a 2-to-1 ratio of oxygen to nitrogen, so the empirical formula is NO_2.

b. The weight of 22.4 liters at S.T.P. is (22.4 liters) × (4.085 g/liter) = 91.4 g, so the molecular weight is 91.4

c. The empirical formula weight is

N: 14.0 × 1 = 14.0
O: 16.0 × 2 = 32.0
46.0

This is about half the molecular weight, so the molecular formula must be N_2O_4.

9-H (c) 1. Molecular weight of CS_2

C: 12.0 × 1 = 12.0
S: 32.1 × 2 = 64.2
76.2

Number of moles in 20 g = (2.0 g)/(76.2 g/mole) = 0.026 mole. Therefore, the volume of 2.0 g at S.T.P. is (22.4 liters/mole) × (0.026 mole) = 0.58 liter so at 756 torr and 50°C the volume is

$$0.58 \text{ liter} \times \frac{760 \text{ torr}}{756 \text{ torr}} \times \frac{323°K}{273°K} =$$

0.69 liter

9-H (d) 1. Balanced equation is $2CO + O \rightarrow 2CO_2$. Molecular weight of CO_2

C: 12.0 × 1 = 12.0
O: 16.0 × 2 = 32.0
44.0

Since half as many moles of O_2 are required to produce a certain number of moles of CO_2, the number of moles of O_2 required is

$$\frac{1}{2} \times \frac{175 \text{ g}}{44.0 \text{ g}} = 1.99 \text{ moles.}$$

The volume of O_2 is therefore 1.99 moles × (22.4 liters/mole) = 44.5 liters.

9-H (e) 1. a. Balanced equation is $2H_2 + O_2 \rightarrow 2H_2O$. Since twice as many moles of hydro-

Gold Cards (con't.)

gen reacted, oxygen remained in excess.

b. The volume at S.T.P. of the mixture would have been

$$4.50 \text{ liters} \times \frac{780 \text{ torr}}{760 \text{ torr}} \times \frac{273°K}{373°K}$$

= 3.38 liters. The number of moles of any gas (or mixture of gases) in 3.38 liters is (3.38 liters)/(22.4 liters/mole) = 0.151 moles. Since half of the molecules were oxygen molecules, there were 0.075 moles of oxygen originally. Half the oxygen molecules reacted with all the hydrogen molecules, leaving 0.038 moles of oxygen in excess.

c. Equal volumes of gas at the same temperature and containing equal numbers of molecules must be at the same pressure. Therefore, since the total pressure of the mixture was 780 torr, the partial pressures of the hydrogen and oxygen were 390 torr each. During the reaction each hydrogen molecule was replaced by a water vapor molecule, and the temperature and volume remained the same. Therefore, the partial pressure due to the water vapor is also 390 torr.

d. Since only half the oxygen molecules reacted, the partial pressure of the oxygen dropped by half, to 195 torr.

CHAPTER 10
PROPERTIES OF SOLIDS AND THEIR SOLUTIONS

White Cards

10-L (a) 1. $K_2CrO_4 + BaCl_2 \rightarrow 2KCl + BaCrO_4$

2. $2K^+_{(aq)} + CrO_4^{2-}{}_{(aq)} + Ba^{2+}_{(aq)} + 2Cl^-_{(aq)} \rightarrow 2K^+_{(aq)} + 2Cl^-_{(aq)} + BaCrO_4{}_{(s)}$

10-L (b) 1. $(NH_4)_2S + Ni(NO_3)_2 \rightarrow 2NH_4NO_3 + NiS$

2. $2NH_4^+{}_{(aq)} + S^{2-}_{(aq)} + Ni^{2+}_{(aq)} + 2NO_3^-{}_{(aq)} \rightarrow 2NH_4^+{}_{(aq)} + 2NO_3^-{}_{(aq)} + NiS_{(s)}$

10-L (c) 1. $2AgNO_3 + BaCl_2 \rightarrow 2AgCl + Ba(NO_3)_2$

2. $2Ag^+_{(aq)} + 2NO_3^-{}_{(aq)} + Ba^{2+}_{(aq)} + 2Cl^-_{(aq)} \rightarrow Ba^{2+}_{(aq)} + 2NO_3^-{}_{(aq)} + 2AgCl_{(s)}$

10-L (d) 1. $2AgNO_3 + Na_2CO_3 \rightarrow 2NaNO_3 + Ag_2CO_3$

2. $2Ag^+_{(aq)} + 2NO_3^-{}_{(aq)} + 2Na^+_{(aq)} + CO_3^{2-}{}_{(aq)} \rightarrow 2Na^+_{(aq)} + 2NO_3^-{}_{(aq)} + Ag_2CO_3{}_{(s)}$

10-L (e) 1. $K_2CrO_4 + Na_2SO_4 \rightarrow K_2SO_4 + Na_2CrO_4$ or $K_2CrO_4 + Na_2SO_4$ or both.

2. $2K^+_{(aq)} + CrO_4^{2-}{}_{(aq)} + 2Na^+_{(aq)} + SO_4^{2-}{}_{(aq)} \rightarrow 2K^+_{(aq)} + CrO_4^{2-}{}_{(aq)} + 2Na^+_{(aq)} + SO_4^{2-}{}_{(aq)}$

Green Cards

10-M (a)(b)(c)(d)(e) See p. 255 of text.

Blue Cards

10-I (a) 1. a. molecular b. metallic
c. ionic d. network
e. metallic

10-I (b) 1. a. metallic b. ionic
c. molecular d. ionic
e. molecular

10-I (c) 1. a. molecular b. ionic
c. metallic d. network
e. molecular

10-I (d) 1. a. ionic b. molecular
c. metallic d. network
e. molecular

Blue Cards (con't.)

10-I (e) 1. a. molecular b. metallic
c. ionic d. metallic
e. molecular

Pink Cards

10-F (a) 1. c. molecules
2. a. deliquescent

10-F (b) 1. b. Solids have definite volume
2. b. molecular

10-F (c) 1. d. solid carbon dioxide
2. c. in the center of the cube

10-F (d) 1. d. in the center of each side of the cube
2. a. ability to diffuse rapidly

10-F (e) 1. b. atoms 2. a. nowhere else

Orange Cards

10-AU(a) 1. A 2. B
10-AU(b) 1. A
2. C, since the atoms are bound by covalent bonds.
10-AU(c) 1. D, since ice is a molecular solid.
2. A
10-AU(d) 1. A
2. B, since no solids tend to diffuse; glass is different because it is not crystalline.
10-AU(e) 1. D, since solids have definite volume.
2. A

Gold Cards

10-H (a) 1. Particles of a gas have more potential energy than particles of a liquid at the same temperature, so more heat is required to change the solid to a gas.
10-H (b) 1. Deliquescence is the picking up of water from the atmosphere. If the water vapor pressure in the air is greater than that in the crystal, the crystal will absorb water until they are equal, according to LeChatelier's Principle.
10-H (c) 1. Crystals that are soft and volatile are likely to be molecular crystals; the forces between particles in molecular crystals are rather weak. Diamond crystals are network solids; the forces between particles in such solids are very strong.
10-H (d) 1. Efflorescence is the giving up of water to the atmosphere by a crystal. When the water vapor pressure in the atmosphere is less than that in the crystal, the crystal gives up moisture to the atmosphere, according to LeChatelier's Principle.
10-H (e) 1. At 4°C the molecules are as close together as they can get. Above 4°C, increased kinetic energy moves them farther apart and the density is less. Below 4°C, more and more hydrogen bonds form. This causes the molecules to assume an arrangement in which there is a great deal of open space, thus decreasing density.

CHAPTER 11
AN INTRODUCTION TO QUALITATIVE ANALYSIS

White Cards

11-L (a...e) This question is an extension of Experiment 11-2. Students will be analyzing a number of unknowns during their work on this experiment. When they present themselves for the chapter test, they should be given an additional unknown. No more than one cation and one anion should be in this unknown. Most students will be able to complete the analysis in one day, but allow extra time if a student needs it. In any case, the rest of the test questions should be drawn at the beginning of the period following completion of the identification of the unknown.

Green Cards

11-M (a) $HCl + AgNO_3 \rightarrow HNO_3 + AgCl$

11-M (b) $H_2S + Cu(NO_3)_2 \rightarrow 2HNO_3 + CuS$

11-M (c) $3(NH_4)_2CO_3 + 2CrCl_3 \rightarrow 6NH_4Cl + Cr_2(CO_3)_3$

11-M (d) $(NH_4)_2S + Zn(NO_3)_2 \rightarrow 2NH_4NO_3 + ZnS$

11-M (e) $BaCl_2 + K_2CrO_4 \rightarrow 2KCl + BaCrO_4$

Blue Cards

11-I (a) 1. (d) Mn^{2+} 2. (c) SO_3^{2-}
11-I (b) 1. (c) K^+ 2. (a) NO_3^-
11-I (c) 1. (d) Fe^{3+} 2. (c) SO_4^{2-}
11-I (d) 1. (a) Sr^{2+} 2. (b) $C_2H_3O_2^-$
11-I (e) 1. (c) Pb^{2+} 2. (b) Br^-

Pink Cards

11-F (a) 1. (b) orange
2. (c) gelatinous texture
11-F (b) 1. (c) pale yellow
2. (b) blood red
11-F (c) 1. (a) common ion
2. (c) violet
11-F (d) 1. (d) rotten eggs
2. (c) hot water
11-F (e) 1. (a) vinegar
2. (d) yellowish green

Orange Cards

11-AU(a) 1. A
11-AU(b) 1. A
11-AU(c) 1. D, since Na_2CO_3 should be added.
11-AU(d) 1. B
11-AU(e) 1. C, since the HCl makes the solution acidic so that the sulfides of the Group II cations

Orange Cards (con't.)

can precipitate.

Gold Cards

11-H (a) 1. See p. 275 of text.

11-H (b) 1. Add $AgNO_3$. If Cl^- ions are present, AgCl will precipitate. This precipitate will dissolve when ammonia water is added, but will precipitate out if enough HNO_3 is added to make solution acidic.

11-H (c) 1. When NaOH solution is added to a solution containing NH_4^+ ions, the OH^- ions react with the NH_4^+ ions to form water and NH_3 molecules.

$$NH_4^+ + OH^- \rightleftarrows NH_3 + H_2O$$

These ammonia molecules can be detected by their characteristic smell.

11-H (d)(e) 1. See pp. 278, 279 of text.

KEYS TO CHEMISTRY

SPECIAL TEST DIRECTIONS

A. Assertion-Reason Questions

Each statement (assertion) in the left-hand column is followed by a reason in the right-hand column. Select

A if BOTH assertion and reason are true statements and the reason is a CORRECT EXPLANATION of the assertion;

B if both assertion and reason are true statements but the reason is NOT a correct explanation of the assertion;

C if the assertion is true, but the reason is a false statement;

D if the assertion is false, but the reason is a true statement;

E if both assertion and reason are false statements.

Directions summarized:

A	True	True	Reason is a correct explanation
B	True	True	Reason is NOT a correct explanation
C	True	False	
D	False	True	
E	False	False	

B. Multiple-Completion Questions

In these questions, ONE or MORE of the choices are correct. Decide which of the responses is(are) correct, then choose

A if only 1, 2, and 3 are correct;

B if only 1 and 3 are correct;

C if only 2 and 4 are correct;

D if only 4 is correct;

E if some other response (or combination of responses) of the ones given is correct.

Directions summarized:

A	B	C	D	E
1,2,3 only	1,3 only	2,4 only	4 only	some other response or combination of those given

KEYS TO CHEMISTRY

ANSWER SHEET - HONOR QUESTION (Gold Card)

Code _____ Name _____

Date _____

Score _____

KEYS TO CHEMISTRY

ANSWER SHEET - LABORATORY APPARATUS - CHAPTER 1

Pieces of laboratory apparatus and equipment have been numbered and placed on display. You will identify each piece of apparatus and/or equipment by writing the appropriate name in the space below. Be sure that you note the correct number and place your answer after that same number on this answer sheet. Spelling will be checked as well as the proper identification of apparatus. Minimum acceptable performance is 95%.

Number	Name of apparatus
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	
18.	
19.	
20.	
21.	
22.	
23.	
24.	

KEYS TO CHEMISTRY

ANSWER SHEET - CHAPTER 1

THE A, B, C's OF CHEMISTRY

Score _____ Name_____

Date_____

Be sure to place the code number which appears in the upper left-hand corner of your test card in the blank space for EACH color. Otherwise, your test cannot be scored.

WHITE CARD: Code _____

1. 2. 3.

GREEN CARD: Code _____

1.

2a. b.

BLUE CARD: Code _____
(If you are asked to make a graph, use a clean sheet of graph paper.)

1a. c.

b. d.

PINK CARD: Code _____ Circle one letter for each question.

1. a b c d 2. a b c d

ORANGE CARD: Code _____ Circle one letter for each question. See direction sheet.

1. A B C D E 2. A B C D E

KEYS TO CHEMISTRY

ANSWER SHEET - CHAPTER 2

CLASSIFICATION OF MATTER

Score _____ Name_____

Date_____

Be sure to place the code number which appears in the upper left-hand corner of your test card in the code blank for EACH color. Otherwise, your test cannot be scored.

WHITE CARD: Code_____

1.

2.

GREEN CARD: Code_____

1a. 2a.

b. b.

c.

BLUE CARD: Code_____

1a.

b.

c.

PINK CARD: Code_____ Circle one letter for each question.

1. a b c d 2. a b c d

ORANGE CARD: Code_____ Circle one letter for each question. See direction sheet.

1. A B C D E 2. A B C D E

KEYS TO CHEMISTRY

ANSWER SHEET - CHAPTER 3

PROPERTIES OF LIQUIDS AND THE SOLUTION PROCESS

Score _____ Name_____

Date_____

Be sure to place the code number which appears in the upper left-hand corner of your test card in the code blank for EACH color. Otherwise, your test cannot be scored.

WHITE CARD: Code_____

1.

GREEN CARD: Code_____ Show and label ALL work.

1.

BLUE CARD: Code_____

1.

2.

PINK CARD: Code_____ Circle one letter for each question.

1. a b c d 2. a b c d

ORANGE CARD: Code____ Circle one letter for each question. See direction sheet.

1. A B C D E 2. A B C D E

KEYS TO CHEMISTRY

ANSWER SHEET - CHAPTER 4

ACIDS, BASES, AND SALTS

Score_____ Name_____

Date_____

Be sure to place the code number which appears in the upper left-hand corner of your test card in the code blank for EACH color. Otherwise, your test cannot be scored.

WHITE CARD: Code _____

1. Answer: Evidence:

2. pH =

GREEN CARD: Code _____

1.

2.

BLUE CARD: Code _____

1.

PINK CARD: Code _____ Circle one letter for each question.

1. a b c d 2. a b c d

ORANGE CARD: Code____Circle one letter for each question. See direction sheet.

1. A B C D E 2. A B C D E

KEYS TO CHEMISTRY

ANSWER SHEET - CHAPTER 5

ATOMIC THEORY

Score _____ Name_____

Date_____

Be sure to place the code number which appears in the upper left-hand corner of your test card in the code blank for EACH color. Otherwise, your test cannot be scored.

WHITE CARD: Code _____

1. Ion:

Evidence:

GREEN CARD: Code _____

1. 2.

BLUE CARD: Code _____ Circle one letter.

1. a b c d

PINK CARD: Code _____

1a.

b.

c.

d.

ORANGE CARD: Code _____ Circle one letter for each question. See direction sheet.

1. A B C D E 2. A B C D E

KEYS TO CHEMISTRY

ANSWER SHEET - CHAPTER 6

ELECTRONIC STRUCTURE OF ATOMS

Score_____ Name_____

Date_____

Be sure to place the code number which appears in the upper left-hand corner of your test card in the code blank for EACH color. Otherwise, your test cannot be scored.

WHITE CARD: Code _____

1. Ion:

   Evidence:

GREEN CARD: Code _____

1. Electron configuration:

2. Orbital notation:

3. Electron dot diagram:

BLUE CARD: Code _____

1. 2. 3. 4. 5.

PINK CARD: Code _____

1.

2.

ORANGE CARD: Code _____ Circle one letter for each question. See direction sheet.

1. A B C D E 2. A B C D E

KEYS TO CHEMISTRY

ANSWER SHEET - CHAPTER 7

CHEMICAL BONDING

Score_____ Name_____

Date_____

Be sure to place the code number which appears in the upper left-hand corner of your test card in the code blank for EACH color. Otherwise, your test cannot be scored.

WHITE CARD: Code _____

1. Bond type:

   Evidence:

GREEN CARD: Code _____

1a. d.

b. e.

c.

BLUE CARD: Code _____ Circle one letter for each question.

1. a b c d e 2. a b c d e

PINK CARD: Code _____

1. Electron dot diagram:

2. Circle one letter: a b c d

ORANGE CARD: Code _____ Circle one letter for each question. See direction sheet.

1. A B C D E 2. A B C D E

KEYS TO CHEMISTRY

ANSWER SHEET - CHAPTER 8

QUANTITATIVE RELATIONSHIPS

Score_____ Name_____

Date_____

Be sure to place the code number which appears in the upper left-hand corner of your test card in the code blank for EACH color. Otherwise, your test cannot be scored.

WHITE CARD: Code _____

1. Show calculations and LABEL all information.

GREEN CARD: Code _____

1a. b. c. d.

BLUE CARD: Code _____

1a.

b.

PINK CARD: Code _____ Circle one letter for each question.

1. a b c d 2. a b c d

ORANGE CARD: Code _____ Circle one letter for each question. See direction sheet.

1. A B C D E 2. A B C D E

KEYS TO CHEMISTRY

ANSWER SHEET - CHAPTER 9

PROPERTIES OF GASES

Score _____ Name _____

Date _____

Be sure to place the code number which appears in the upper left-hand corner of your test card in the code blank for EACH color. Otherwise, your test cannot be scored.

WHITE CARD: Code _____

1a.

b.

GREEN CARD: Code _____ Show ALL work properly labeled.

1.

BLUE CARD: Code _____ If calculations are required, show ALL work properly labeled.

1.

PINK CARD: Code _____ Circle one letter for each question.

1. a b c d 2. a b c d

ORANGE CARD: Code _____ Circle one letter for each question. See direction sheet.

1. A B C D E 2. A B C D E

KEYS TO CHEMISTRY

ANSWER SHEET - CHAPTER 10

SOLIDS AND THEIR SOLUTIONS

Score _____ Name_____

Date_____

Be sure to place the code number which appears in the upper left-hand corner of your test card in the code blank for EACH color. Otherwise, your test cannot be scored.

WHITE CARD: Code _____

1.

2.

GREEN CARD: Code _____

1.

BLUE CARD: Code _____

1a. d.

b. e.

c.

PINK CARD: Code _____ Circle one letter for each question.

1. a b c d 2. a b c d

ORANGE CARD: Code ____ Circle one letter for each question. See direction sheet.

1. A B C D E 2. A B C D E

KEYS TO CHEMISTRY

ANSWER SHEET - CHAPTER 11

QUALITATIVE ANALYSIS

Score _____ Name_____

Date_____

Be sure to place the code number which appears in the upper left-hand corner of your test card in the code blank for EACH color. Otherwise, your test cannot be scored.

WHITE CARD: Code _____

1. Cation:

   Evidence:

   Anion:

   Evidence:

GREEN CARD: Code _____

1.

BLUE CARD: Code _____ Circle one letter for each question.

1. a b c d 2. a b c d

PINK CARD: Code _____ Circle one letter for each question.

1. a b c d 2. a b c d

ORANGE CARD: Code _____ Circle one letter. See direction sheet.

1. A B C D E

KEYS TO CHEMISTRY

REPORT SHEET - CHAPTER 1

THE A, B, C's OF CHEMISTRY

Name_____

Date_____

Your score on this test is _____

On the basis of this score, you are advised to:

_____ 1. Proceed to the next chapter on your schedule.

_____ 2. Review the topics checked below and take the test again.

_____ a. reading of balances and graduated cylinders

_____ b. principles of laboratory investigation

_____ c. properties of matter

_____ d. International System of Units

_____ e. measurement of temperature and heat

_____ f. precision and accuracy in measurement

_____ g. significant figures

_____ h. calculation of percentage error

_____ i. principles of graphing

_____ j. graph interpretation

_____ k. density

_____ l. equilibrium

_____ m. energy versus randomness

_____ n. other_____

_____

Instructor

KEYS TO CHEMISTRY

REPORT SHEET - CHAPTER 2

CLASSIFICATION OF MATTER

Name_____

Date_____

Your score on this test is _____

On the basis of this score, you are advised to:

_____ 1. Proceed to the next chapter on your schedule.

_____ 2. Review the topics checked below and take the test again.

_____ a. physical and chemical properties of matter

_____ b. physical and chemical changes in matter

_____ c. characteristics of the states of matter

_____ d. characteristics of elements, mixtures, and compounds

_____ e. characteristics of metals and nonmetals

_____ f. characteristics of homogeneous and heterogeneous matter

_____ g. the Law of Definite Proportions

_____ h. changes in state of matter

_____ i. kinetic and potential energy concepts

_____ j. chemical symbols of elements

_____ k. elements in the lithosphere

_____ l. data interpretation

_____ m. other _____

_____

Instructor

KEYS TO CHEMISTRY

REPORT SHEET - CHAPTER 3

PROPERTIES OF LIQUIDS AND THE SOLUTION PROCESS

Name_____

Date_____

Your score on this test is _____

On the basis of this score, you are advised to:

_____ 1. Proceed to the next chapter on your schedule.

_____ 2. Review the topics checked below and take the test again.

_____ a. checking for dissolved solid

_____ b. equilibrium versus steady state

_____ c. endothermic and exothermic reactions

_____ d. evaporation

_____ e. properties of liquids

_____ f. vapor pressure and boiling point

_____ g. Le Chatelier's Principle

_____ h. phase changes: randomness versus minimum energy

_____ i. properties of water

_____ j. properties of solutions

_____ k. interpretation of solubility graphs

_____ l. solubility of solids and gases

_____ m. atomic, molecular, and formula weight

_____ n. molarity of solutions

_____ o. effect of water density on lakes

_____ p. other _____

_____
Instructor

KEYS TO CHEMISTRY

REPORT SHEET - CHAPTER 4

ACIDS, BASES, AND SALTS

Name _____

Date _____

Your score on this test is _____

On the basis of this score, you are advised to:

_____ 1. Proceed to the next chapter on your schedule.

_____ 2. Review the topics checked below and take the test again.

_____ a. theory of ionization

_____ b. strong and weak electrolytes

_____ c. properties of acids

_____ d. properties of bases

_____ e. properties of salts

_____ f. naming acids and bases

_____ g. laboratory measurement of pH

_____ h. calculation of pH

_____ i. hydrolysis

_____ j. application of Le Chatelier's Principle

_____ k. buffers and the common ion

_____ l. other _____

_____

Instructor

KEYS TO CHEMISTRY

REPORT SHEET - CHAPTER 5

ATOMIC THEORY

Name _____

Date _____

Your score on this test is _____

On the basis of this score, you are advised to:

_____ 1. Proceed to the next chapter on your schedule.

_____ 2. Review the topics checked below and take the test again.

_____ a. contributions of major scientists

_____ b. the Law of Definite Proportions

_____ c. Dalton's work

_____ d. "black boxes"

_____ e. properties of waves

_____ f. relation between frequency and wavelength

_____ g. major models for atomic structure

_____ h. flame tests for metallic ions

_____ i. Rutherford's experiment

_____ j. Bohr's model of the atom

_____ k. the nature of light

_____ l. the electrical nature of matter

_____ m. radioactivity

_____ n. atomic spectra

_____ o. other _____

_____

Instructor

KEYS TO CHEMISTRY

REPORT SHEET - CHAPTER 6

ELECTRONIC STRUCTURE OF ATOMS

Name _____

Date _____

Your score on this test is _____

On the basis of this score, you are advised to:

_____ 1. Proceed to the next chapter on your schedule.

_____ 2. Review the topics checked below and take the test again.

_____ a. the atomic nucleus and isotopes

_____ b. protons, neutrons, and electrons

_____ c. electron configurations

_____ d. orbital notation

_____ e. electron dot notation

_____ f. the size of atoms

_____ g. the meaning and significance of atomic numbers

_____ h. contributions of scientists

_____ i. models of the atom

_____ j. energy levels and orbitals

_____ k. characteristics of major chemical families and series

_____ l. characteristics of the periodic table

_____ m. trends in families on the periodic table

_____ n. trends in periods on the periodic table

_____ o. laboratory identification of Group I and Group II cations

_____ p. transition elements

_____ q. other_____

_____

Instructor

KEYS TO CHEMISTRY

REPORT SHEET - CHAPTER 7

CHEMICAL BONDING

Name _____

Date _____

Your score on this test is _____

On the basis of this score, you are advised to:

_____ 1. Proceed to the next chapter on your schedule.

_____ 2. Review the topics checked below and take the test again.

- _____ a. bond types and solubility
- _____ b. types of bonds between atoms and ions
- _____ c. types of bonds between molecules
- _____ d. polar and nonpolar molecules
- _____ e. trends in ionization energy with increasing atomic number
- _____ f. trends in electronegativity with increasing atomic number
- _____ g. use of the periodic table of electronegativities
- _____ h. prediction of bond types
- _____ i. effect of bond types on properties of substances
- _____ j. effect of ionic radius
- _____ k. electron dot diagrams
- _____ l. van der Waals forces
- _____ m. empirical and molecular formulas
- _____ n. other _____

_____

Instructor

KEYS TO CHEMISTRY

REPORT SHEET - CHAPTER 8

QUANTITATIVE RELATIONSHIPS

Name _____

Date _____

Your score on this test is _____

On the basis of this score, you are advised to:

_____ 1. Proceed to the next chapter on your schedule.

_____ 2. Review the topics checked below and take the test again.

_____ a. determination of number of moles in a laboratory sample

_____ b. atomic weights

_____ c. formula writing

_____ d. formula interpretation

_____ e. naming compounds

_____ f. oxidation number

_____ g. calculation of formula and molecular weights

_____ h. the mole concept

_____ i. interpretation of chemical sentences and equations

_____ j. balancing equations

_____ k. types of chemical reactions

_____ l. other _____

_____

Instructor

KEYS TO CHEMISTRY

REPORT SHEET - CHAPTER 9

PROPERTIES OF GASES

Name _____

Date _____

Your score on this test is _____

On the basis of this score, you are advised to:

_____ 1. Proceed to the next chapter on your schedule.

_____ 2. Review the topics checked below and take the test again.

_____ a. effect of pressure on the volume of a gas

_____ b. effect of temperature on the volume of a gas

_____ c. application of Charles' Law

_____ d. application of Boyle's Law

_____ e. partial pressure of gases collected over water

_____ f. meaning of standard temperature and pressure

_____ g. interpretation of graphs

_____ h. molar volume of gases

_____ i. relation between molecular weight and density of gases at S. T. P.

_____ j. absolute temperature

_____ k. characteristics of gases

_____ l. measurement of gas pressure

_____ m. correction of gas volumes to S. T. P.

_____ n. properties of real and ideal gases

_____ o. other _____

_____

Instructor

KEYS TO CHEMISTRY

REPORT SHEET - CHAPTER 10

SOLIDS AND THEIR SOLUTIONS

Name _____

Date _____

Your score on this test is _____

On the basis of this score, you are advised to:

_____ 1. Proceed to the next chapter on your schedule.

_____ 2. Review the topics checked below and take the test again.

_____ a. types of unit cells

_____ b. properties of solids

_____ c. writing equations for reactions that occurred in Exp. 10-3

_____ d. writing ionic equations

_____ e. deliquescence and efflorescence

_____ f. bonding types in crystals

_____ g. melting and sublimation

_____ h. structure of water

_____ i. other _____

_____

Instructor

KEYS TO CHEMISTRY

REPORT SHEET - CHAPTER 11

QUALITATIVE ANALYSIS

Name _____

Date _____

Your score on this test is _____

On the basis of this score, you are advised to:

_____ 1. Rejoice. The course is over!

_____ 2. Review the topics checked below and take the test again.

_____ a. cation tests

_____ b. anion tests

_____ c. function of reagents

_____ d. flame tests

_____ e. completing and balancing equations

_____ f. other _____

_____
Instructor

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